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THE CENTRAL TENDENCY OF JUDGMENT

SINCE the work of the early investigators of the time sense the concept of the "indifference point" (I.P.) has played an ever-present rôle in experiments on judgments of magnitude, duration, and intensity. Judgments of time, weight, force, brightness, extent of movement, length, area, size of angles, have all shown the same tendency to gravitate toward a mean magnitude, the result being that stimuli above that point in the objective scale were underestimated and stimuli below overestimated, while the mean magnitude itself was invested with no constant error. This region in the scale, flanked above and below by negative and positive constant errors, was called the indifference point, or more properly the region of indifference.

The tendency has been throughout to infer that the I.P. disclosed in any particular experiment was in some way an absolute quantity and should be found in other experiments on the same quality of stimulus. In this way arose the ideas of a "most favorable extent" (Kramer and Moskiewicz, Jaensch) and a "most favorable time" (Vierordt, Höring, Estel, etc.). Among the investigators of the time sense, since an I.P. was found for every group of intervals employed, grew up the doctrine of periodic I.P.'s, those for regions higher up in the scale being multiples of the I.P.'s found in the experiment in which the shortest intervals were used. Attempts were made to correlate the unit of periodicity with various bodily processes—the swing of the leg, breathing time, pulse beat (Wundt, Münsterberg). All of this speculation passed the criticism of laboratory workers and was incorporated in the general texts as a curious fact, productive of many illusions and constant errors, but the analysis was carried no farther.

In an earlier study[1] the writer undertook an experimental analysis of the phenomenon of the I.P. in judgments of the duration and extent of rectilinear arm movements. The results of this investigation showed conclusively that, with the method of reproduction, the following principles hold.

I. The I.P. is relative,—not absolute. It is a function of the series limits of the stimuli employed. Given the series of magnitudes with which we are to work, we may be quite certain that a region of indifference will occur at about the midpoint of that particular scale.

II. A periodic I.P. can be found within a total series (S) by working with its special sections (A, B and C).

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[1] "The Inaccuracy of Movement" (with special reference to constant errors), H. L. Hollingworth, Columbia Contributions, Vol. XVII., No. 3, June, 1909.

III. The same absolute magnitude may be either an I.P., or affected with a positive constant error, or with a negative constant error, according to the particular range or section in which it occurs.

IV. The gradual extension of the series limits is accompanied by a corresponding shift in the region of indifference.

V. No magnitude estimated out of relation to a series or group of which it is a member evinces any considerable constant error.

VI. The phenomenon of the I.P. disappears as the interval between separate judgments is extended. The first disposition is soon dissipated and is no longer adequate to affect the second performance.

VII. In a parallel tabulation of the I.P.'s and the ranges of intervals used in the various time-sense studies the influence of the latter on the magnitude of the I.P. is clearly seen.

VIII. The phenomenon of the I.P. and the so-called positive and negative time errors result from a general law—*the central tendency of judgment.* In all estimates of stimuli belonging to a given range or group we tend to form our judgments around the median value of the series—toward this mean each judgment is shifted by virtue of a mental set corresponding to the particular range in question. This *central tendency* is not a "law of sense memory." It is a law of immediate perception and disappears as the experiment becomes a memory test.

IX. In experiments by the method of reproduction this *central tendency* is reenforced by the law of motor habit.

For an account of the experiments on which these conclusions rest and for detailed exposition of their significance the reader must be referred to the earlier study.

THE PRESENT STUDY

Purpose.—On account of the reenforcing value of the law of motor habit the earlier experiments did not indicate how clearly or in how far the results secured were a function of the method of motor reproduction. In order to support the case completely it should be shown that the same law of judgment is present in experiments into which the method of reproduction does not enter. In order to put the generalization to such a test the following experiments have been made on judgments of the size of squares, by the method of recognition.

Observers.—The observers were all women students in Barnard College with from one and a half to two and a half years of training in psychology. Different observers were used in the two experiments and none of them knew the purpose of the experiment, nor were they familiar with the results of the earlier study.

Material.—The material used in both experiments A and B was the same, the chief differences between the experiments consisting in the way in which the series limits were varied. On a dark gray wall were placed 30 squares of light gray cardboard, ranging in size from 2.5 cm. on a side to 50 cm. and increasing from 2.5 to 7 cm. by increments of 0.5 cm., from 7 to 15 cm. by increments of 1 cm., from 15 to 40 cm. by increments of 2.5 cm., and on to 50 cm. by increments of 5 cm. Each card was numbered in consecutive order. Alongside these standard cards and at the same distance from the observer was an exposure apparatus, by means of which, at proper intervals, the fourteen test cards could be presented one at a time. These test cards varied in size from 3 cm. to 40 cm. on the side, ranging from 3 to 7 cm. by increments of 1 cm., from 7 to 15 cm. by increments of 2 cm., from 15 to 40 cm. by increments of 5 cm.

Procedure.—In each experiment a test card was exposed for 5 seconds. The observer then waited for 5 seconds, the eyes resting meanwhile on a dark screen. She then turned to the standard series and was allowed 5 seconds in which to select a card corresponding in size to the one just exposed and to write its number in her record. A second test card was then exposed, and so on throughout the experiment. By keeping a record of the order in which the test cards were shown, the experimenter was able subsequently to compare the observer's judgment with the actual magnitude. As a result of this method of selection all constant errors due to the law of motor habit in reproduction are eliminated and any error disclosed will be entirely an error of judgment of visual magnitude.

EXPERIMENT A

This experiment began with series 3, 4, 5, 6, 7, three trials for each magnitude, in chance order. The smallest card (3) was then dropped and the larger card (9) substituted, and three trials taken in chance order, for each member in the new series 4, 5, 6, 7, 9. In this way the successive series moved up along the total range, dropping at each change its lowest member and including the one next larger than its greatest member. The series, that is to say, always consisted of 5 test cards, and as the experiment progressed, magnitudes were dropped from the lower end and new ones added to the upper end. Ten observers were used, 150 trials being taken on each observer. Table I. gives the C.E. of the 10 observers in terms of the square root of the area—that is, in terms of the length of one side of the square. Each figure is the C.E. resulting from 30 judgments.

TABLE I

GIVES THE C.E. IN CM. OF EACH CARD IN EXPERIMENT A.
10 OBSERVERS, 1,500 TRIALS

	3	4	5	6	7	9	11	13	15	20	25	30	35	40
1	0	—.13	—.23	—.24	—.21									
2		+.15	+.52	+.53	—.01	+.44								
3			+.51	+.15	—.11	+.32	+ .31							
4				+.19	+.39	+.55	+ .21	— .02						
5					+.31	+.21	+ .42	— .13	0					
6						+.74	+ .75	+ .64	+ .56	+ .48				
7							+1.31	+ .80	+1.37	+1.73	+2.15			
8								+1.39	+1.60	+1.84	+1.43	+1.92		
9									+ .94	+1.72	+2.15	+ .98	+.90	
10										+2.40	+2.65	+1.50	+.45	+1.78

EXPERIMENT B

This experiment began with the series 3, 4, 5, 6, 7, 9. Three trials for each magnitude were taken in chance order. The next higher magnitude (11) was then added to the series and again 3 trials for each magnitude (3–11) were taken in chance order. At this point the next magnitude (13) was introduced, 3 trials for each card taken, and the process continued until in the ninth series the whole range of test cards from 3 to 40 was included. Six observers were used, 270 records being taken from each observer. Table II. gives the C.E. of the 6 observers for each magnitude in each succeeding series. As in Table I. the errors are given in terms of one side of the square. Each figure in the table is the C.E. of 18 judgments of the same card.

TABLE II

GIVES THE C.E. OF EACH CARD IN EXPERIMENT B.
6 OBSERVERS, 1,620 TRIALS

	3	4	5	6	7	9	11	13	15	20	25	30	35	40
1	.03	.10	.08	.42	.25	.58								
2	.03	.17	.15	.45	.25	.65	.86							
3	.03	.26	.48	.60	.11	.80	.89	.60						
4	.03	.53	.73	.88	.45	.40	.53	.65	1.43					
5	.03	.65	.98	.83	1.05	.43	.36	.52	1.60	2.63				
6	.05	.65	1.05	.78	.85	.72	.43	— .25	1.62	2.05	2.40			
7	.03	.76	1.05	.90	.92	.93	.80	1.00	1.35	1.73	2.25	4.82		
8	.05	.87	1.12	.73	1.23	.70	.82	1.83	1.27	1.77	1.63	1.85	3.08	
9	.08	.68	1.08	.87	1.10	.75	.42	.92	1.52	1.57	1.43	.97	2.10	4.42

In each of these experiments we have another case of the gradual extension of series limits, and if the *law of central tendency* is operative, I.P.'s might be expected to occur in each series and gradually to rise in the range as the larger magnitudes are added. The A.E. and its variability are not given in the tables, since only the C.E. is of interest for the problem in hand. As a matter of fact the phenomenon of the I.P. is concealed in both experiments by a strong positive constant error which comes from a general tendency to overestimation in judgments of square magnitudes. This tendency has been found by other investigators. Woodworth and Thorndike find a positive constant error in estimates of area by a mental standard. Baldwin, Shaw, and Warren find the same tendency in judgments of the size of squares and attribute it to a change in the memory image. This error, however, is irrelevant to the present problem. The important fact is that underneath this ever-present overestimation the *law of central tendency* is also operative, and its presence can be clearly shown by a proper analysis of the figures.

Casual examination of Table I. shows that the positive constant error for any one magnitude increases as the place of the magnitude in the series descends. Thus the — C.E. (— .21) for card 7 in series 1 changes to a decided + C.E. (+ .39, + .31) in series 4 and 5. The + C.E. (+ .31) of card 11 increases to + 1.31 in series 7, and the errors of the other cards undergo in a strikingly uniform way the same transformation. This is a clear indication that in any one series the magnitude is influenced by other magnitudes occurring above and below it and is in every case shifted toward the center of the series. Thus in series 1 card 7 is drawn toward the smaller magnitudes, and its judgment results in a — C.E. In series 5 the same card is drawn toward a higher set of magnitudes and hence acquires a decided + C.E.

The process is clearly shown by an examination of the 6 cards (7 to 20, inclusive) that occurred in all 10 series. Each of these cards occupied, in the course of the experiment, all 5 positions. Thus card II. is in series 3 the largest magnitude; in series 7 it is the lowest; in series 5 it is the central card; while in series 4 and 6 it occupies the intermediate positions on either side of the center. The same, in appropriate series, is true of all 6 cards, from 7 to 20 inclusive. Now if there were no source of error present except the *central tendency of judgment* each card should have theoretically no C.E. when it occurred in the middle of a series, *i. e.*, it should be the I.P. for that series. But, since there is another error present due to the general tendency to overestimation in judgments of square size, the theoretical conditions are not fulfilled, and each card, even when it occurs in the central position, shows an actual + C.E. We may assume, then, that the error shown in this central position is due to the character of the material, and that so far as the *law of central tendency* is concerned it may be considered 0, or what we might call the *normal error.* If the errors of any magnitude in the successive series from 1–10 be calculated with respect to this *normal error,* the operation of the *law of central tendency* should lead to the following results. As the series progress the relative errors of any magnitude, that is, the deviations of the actual from the *normal errors,* should show an I.P. phenomenon—they should be negative above the normal, zero at the normal, and positive below it. The facts are shown in Table III., in which, for cards 7–20, the error of each card when it occurred in central position is assumed to be *normal.* It will be seen that above the normal the errors are, with a single exception, negative, while below they are, with only three exceptions, positive. The transformation is from a high — value through 0 to a high + value.

TABLE III

7	9	11	13	15	20
—.10	—.11	—.11	—.66	—1.37	—1.32
+.10	—.23	—.21	—.77	— .81	— .11
0	0	0	0	0	0
+.28	—.34	+.33	+.16	+ .23	— .12
+.20	+.19	+.89	+.75	+ .43	+ .68

Thus from any point of view in which the figures may be regarded the *central tendency of judgment* is revealed, working, however, underneath a general tendency to overestimation. This result is confirmed by the results of Experiment B, in which the lower magnitudes were allowed to remain in the series while the higher were being added. The results appear in Table II. Again there is present the positive constant error due to the character of the material, but underneath the *central tendency* is clearly to be seen.

The magnitudes here used fall into three groups. To the first group belong cards 3–9, present in all 9 series, and influenced in judgment by the gradual inclusion of the higher magnitudes 11–40. According to the aforestated law the effect of these higher magnitudes should be to draw the lower cards toward a constantly augmenting center, that is, as the higher cards appear one by one, the central tendency of the respective series rises. The positive errors of cards 3–9 should thus become constantly greater as the experiment proceeds. Again the deductions are strikingly verified. Thus the error of card 4 increases from + .10 in series 1 to + .68 in series 9; that of 5 from + .08 in series 1 to + 1.08 in series 9, etc. This effect is due, in any one series, partly to the introduction of still higher magnitudes, partly to habituation to the larger cards already introduced and now being repeated.

The second group of magnitudes consists of cards 20 to 40 inclusive. When any one of these cards, say 20, is introduced, the observer is already considerably adapted to the lower magnitudes, and as the next higher card (25) is introduced in the following series this adaptation to the lower cards is much furthered by the fact that each of the 9 cards below 20 is again repeated three times, while adaptation to magnitudes higher than 20 is only slightly begun by the threefold repetition of card 25. The consequence is that as the experiment proceeds habituation to the lower range increases much more rapidly, at first, than that to the upper range, on account of the greater number of lower cards. In this group, then, we should expect transformations just the reverse of those in group I., that is, the + C.E.'s should become constantly smaller as the high card is drawn more and more in judgment toward the center of the series. Again expectation is confirmed. The error of card 20 falls from + 2.63 in series 5 to +1.57 in series 9; that of card 25 from + 2.40 to + 1.43; that of card 30 from + 4.82 to + .97; and that of card 35 from + 3.08 to + 2.10.

There remain yet to be considered the three cards 11, 13, and 15, comprising group three. This group, standing as it does midway between groups one and two, which show directly opposite transformations, might be expected to show either of two results. First, the two tendencies might neutralize each other, the errors in group three remaining approximately constant or varying irregularly. Second, the first tendency might operate in the first few series, after which, by virtue of increasing habituation to the larger cards the second tendency might begin to assert itself in the later series. So far as the figures go they are sufficiently irregular to admit of either interpretation. There is neither uniform increase nor decrease throughout. There is, in fact, a strong suggestion of the second possible result—initial decrease followed by increase as habituation to higher magnitudes grows. Thus the errors of card 11 fall from + .86 in series 2 to + .36 in series 5, then increase to + .80 and + .82 in later series. Card 13 falls from + .60 in series 1 to — .25 in series 6, then increases to over + 1.00 in series 7–9. Card 15 falls to + 1.35 in series 7, increasing to + 1.50 in the last series.

TABLE IV

	3	4	5	6	7	9
1	—.01	—.42	—.67	—.30	—.44	—.08
2	—.01	—.35	—.60	—.27	—.44	—.01
3	—.01	—.26	—.27	—.12	—.58	+.14
4	—.01	+.01	—.02	+.16	—.24	—.26
5	—.01	+.13	+.23	+.11	+.36	—.23
6	+.01	+.13	+.30	+.06	+.16	+.06
7	—.01	+.24	+.30	+.18	+.23	+.27
8	+.01	+.35	+.37	+.01	+.59	+.04
9	+.04	+.16	+.33	+.15	+.41	+.09

One could scarcely ask for more convincing evidence of the *law of central tendency* than that afforded by the behavior of the C.E.'s in these three groups of magnitudes. The evidence may be reenforced, however, and the process more clearly exhibited by further treatment of the errors in group I., consisting of cards which were present in all 9 series. In the case of this experiment we have no means of determining, as we did in experiment A, the normal error due to the character of the material. We may, however, observe the deviations of the errors in a given series from the average of the errors in the whole 9 series. These deviations should show, as did Table III. for experiment A, an indifference point phenomenon for the errors of any given magnitude in successive series. Such a calculation results in Table IV. As was to be expected, the I.P. phenomenon is clearly present. The successive deviations from the average, in the case of the errors for any given magnitude, pass from pronounced negative direction through an approximate zero point to a pronounced positive direction. This change was caused in every case by the inclusion of higher magnitudes in the series, thus producing an upward shift in the central tendency or median of the series, toward which each lower magnitude was assimilated in greater or less degree, according to the amount of habituation to the upper range.

It is not necessary to go further into the theoretical and interpretative consideration of *the law of central tendency,* since the writer has already discussed this elsewhere.[2] But it should be pointed out that none of the factors usually introduced to explain the occurrence of indifference points are adequate. Unexplained differences in time error (Fechner), mechanical sources of error in apparatus (Schumann), peculiarity of the sense organ (Vierordt), lack of current motor control (Delabarre), relative expenditure of energy (Wundt), change in the memory image (Wreschner, Leuba), fatigue and dynamogeny, all these may contribute their share toward the actual magnitude of a given error, but their influence can hardly be conceived as varying up and down a scale of objective magnitudes in such a way as to account for the shifting I.P. with extension of the series limits.

Nor is the phenomenon in any way the result of contrast. It is, on the contrary, just the reverse—a case of two magnitudes approximating each other in judgment by virtue of their temporal contiguity. The tendency seems explicable only in terms of itself. Just as our experience with a race, class, or social group results in the conception of a *type* which shall in some way represent the central tendency of the group, and from which the separate members shall deviate the least, so in an experiment on sensible discrimination we become adapted to the median value of the series, tend to expect it, to assimilate all other values toward it, and to greater or less degree to substitute it for them. Either this tendency is the rudimentary process out of which the higher acts of conception grow, or it is the habit of conception extended to sensory fields and interfering with a quite elementary process of comparison and recognition. The importance of the law in any series of psychophysical measurements should be apparent. The error to which it leads is distinctly an error of judgment, and is quite independent of sensory or physiological conditions which may of themselves be sources of other types of errors.

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[2] "Inaccuracy of Movement," chapter III.

H. L. HOLLINGWORTH.

COLUMBIA UNIVERSITY.

REVIEWS AND ABSTRACTS OF LITERATURE

The Individual and Reality. An essay touching the first principles of metaphysics. EDWARD DOUGLASS FAUCETT. New York, London, Bombay, Calcutta: Longmans, Green, & Co. 1909. Pp. xxiv + 449.

A work which is hailed by William James "as a great and powerful agency in the spreading of truth" naturally invites attention. The book —modestly called an "essay"—is one more indication, and a striking one, of the strong modern movement toward the fusion, or at least the working combination, of the antithetic streams of thought represented by the terms individuality and continuity. In his "Riddle," published in 1893, the author was a pronounced individualist, championing a thoroughgoing monadology; in the present work the individual, though by no means surrendered or explained away, is abundantly supplied with "doors and windows." It is described as a "center" in an essentially continuous universe; not *the* center, for the outlook is entirely pluralistic; but one of innumerable centers, all of which are open to the tides and pulsations of the cosmos. They are "emphases, foci of intense activity, traveling eddies, as it were, within a MOTHER-STUFF COESSENTIAL WITH OURSELVES." The author's system is thus at once dynamic and objectively idealistic. He calls it a "real-idealism" or an "idealistic dynamism." All existence is alive, differences being purely matters of extent and type of organization.

With his metaphysical interest Mr. Faucett combines a lively concern as to the ethical outlook. He finds no morality whatever in nature, which is fundamentally blindly impulsive and non-rational. Yet there are two fundamental characteristics of existence which render it increasingly amenable to the guidance of mind, and so susceptible of ends of value, or moral outcomes. These are a blind groping toward unimpeded and enlarged activity and a large measure of plasticity; and on the strength of them he holds to a "far-off divine event," toward which